§101.111 Emission limitations.

(a) The mean power of emissions must be attenuated below the mean output power of the transmitter in accordance with the following schedule:

(1) When using transmissions other than those employing digital modulation techniques:

(i) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 decibels;

(ii) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 decibels;

(iii) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43+10\ \text{Log}_{10}$ (mean output power in watts) decibels, or 80 decibels, whichever is the lesser attenuation.

(2) When using transmissions employing digital modulation techniques (see §101.141(b)) in situations not covered in this section:

(i) For operating frequencies below 15 GHz, in any 4 KHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 250 percent of the authorized bandwidth: As specified by the following equation but in no event less than 50 decibels.

$A=35+0.8(P-50)+10\ \text{Log}_{10}B$. (Attenuation greater than 80 decibels is not required.)

where:

A=Attenuation (in decibels) below the mean output power level.
P=Percent removed from the carrier frequency.
B=Authorized bandwidth in MHz.

(ii) For operating frequencies above 15 GHz, in any 1 MHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 250 percent of the authorized bandwidth: As specified by the following equation but in no event less than 11 decibels.
$A=11+0.4(P-50)+10\ \text{Log}_{10}B$. (Attenuation greater than 56 decibels is not required.)

(iii) In any 4 KHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43+10\ \text{Log}_{10}$ (mean output power in watts) decibels, or 80 decibels, whichever is the lesser attenuation.

(3) For Digital Termination System channels used in the Digital Electronic Message Service (DEMS) operating in the 10,550-10,680 MHz band:

(i) In any 4 KHz band, the center frequency of which is removed from the edge of the DEMS channel by up to and including 1.125 times the DEMS subchannel bandwidth: As specified by the following equation may in no event be less than $50+10 \log_{10}$ N decibels.

$A=50+0.0333\ (F-0.5B)+10 \log_{10}$ N decibels

Where:
A=Attenuation (in decibels) below means output power level contained within the DEMS channel for a given polarization.
B=Bandwidth of DEMS channel (in KHz).
F=Absolute value of the difference between the center frequency of the 4 KHz band measured and the center frequency of the DEMS channel (in KHz).
N=Number of active subchannels of the given polarization within the DEMS channel.

(ii) In any 4 KHz band within the authorized DEMS band the center frequency of which is removed from the center frequency of the DEMS channel by more ~~that~~ than the sum of 50% of the DEMS channel bandwidth plus 1.125 times the subchannel bandwidth: As specified by the following equation but in no event less than 80 decibels.

$A=80+10 \log_{10}$ N decibels

(iii) In any 4 KHz band the center frequency of which is outside the authorized DEMS band: At least $43+10 \log_{10}$ (mean output power in Watts) decibels.

(4) For Digital Termination System channels used in the Digital Electronic Message Service (DEMS) operating in the 17,700-19,700 MHz band:

(i) In any 4 KHz band, the center frequency of which is removed from the frequency of the center of the DEMS channel by more than 50 percent of the DEMS channel bandwidth up to and including 50 percent plus 500 KHz: As specified by the following equation but in no event be less than $50+10 \log_{10}$ N decibels.

$A=50+0.06\ (F-0.5B)+10 \log_{10}$ N decibels

Where:
A=Attenuation (in decibels) below means output power level contained within the DEMS channel for a given polarization.
B=Bandwidth of DEMS channel (in KHz).
F=Absolute value of the difference between the center frequency of the 4 KHz band measured and the center frequency of the DEMS channel (in KHz).
N=Number of active subchannels of the given polarization within the DEMS channel.

(ii) In any 4 KHz band within the authorized DEMS band, the center frequency of which is removed from the center frequency of the DEMS channel by more than the sum of 50 percent of the channel bandwidth plus 500 KHz: as specified by the following equation but in no event less than 80 decibels.

$A=80+10 \log_{10} N$ decibels

(iii) In any 4 KHz band the center frequency of which is outside the authorized Digital Message Service band:

At least $43+10 \log_{10}$ (mean output power in Watts) decibels.

(5) When using transmissions employing digital modulation techniques on the 900 MHz multiple address frequencies with a 12.5 KHz bandwidth, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) in accordance with the following schedule:

(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 2.5 KHz up to and including 6.25 KHz: At least $53 \log_{10}$ (fd/2.5) decibels;

(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 6.25 KHz up to and including 9.5 KHz: At least $103 \log_{10}$ (fd/3.9) decibels;

(iii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 9.5 KHz up to and including 15 KHz: At least $157 \log_{10}$ (fd/5.3) decibels;

(iv) On any frequency removed from the center of the authorized bandwidth by a displacement frequency greater than 15 KHz: At least 50 plus $10 \log_{10}$(P) or 70 decibels, whichever is the lesser attenuation.

(4) When using transmissions employing digital modulation techniques on the 900 MHz multiple address frequencies with a bandwidth greater than 12.5 KHz, the power of

any emission must be attenuated below the unmodulated carrier power of the transmitter (P) in accordance with the following schedule;

(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 5 KHz up to and including 10 KHz: At least 83 $\log_{10}$ (fd/5) decibels;

(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 10 KHz up to and including 250 percent of the authorized bandwidth: At least 116 $\log_{10}$ (fd/6.1) decibels or 50 plus 10 $\log_{10}$ (P) or 70 decibels, whichever is the lesser attenuation;

(iii) On any frequency removed from the center of the authorized bandwidth by more that 250 percent of the authorized bandwidth: At least 43 plus 10 $\log_{10}$ (output power in watts) decibels or 80 decibels, whichever is the lesser attenuation.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraph (a) of this section.

(c) The emission of an unmodulated carrier is prohibited except for test purposes as required for proper station and system maintenance.

§101.113 Transmitter power limitations.

(a) On any authorized frequency, the average power delivered to an antenna in this service must be the minimum amount of power necessary to carry out the communications desired. Application of this principle includes, but is not to be limited to, requiring a licensee who replaces one or more of its antennas with larger antennas to reduce its antenna input power by an amount appropriate to compensate for the increased primary lobe gain of the replacement antenna(s). In no event shall the average equivalent isotropically radiated power (EIRP), as referenced to an isotropic radiator, exceed the values specified below. In cases of harmful interference, the Commission may, after notice and opportunity for hearing, order a change in the effective radiated power of this station. Further, the output power of a transmitter on any authorized frequency in this service may not exceed the following:

Frequency Band (MHz)	Maximum allowable EIRP (1)*	
	Fixed (dBW)	Mobile (dBW)
928.0 to 929.0	+17	....
932.0 to 932.5	+17	....
932.5 to 935.0	+40	....
941.0 to 941.5	+30	....
941.5 to 944.0	+40	....
952.0 to 960.0 (1)	~~(1)~~ +40	....
1,850 to 1,990	+45	....
2,110 to ~~2,160~~ 2,130	~~(4)~~ +45	....
2,130 to 2,150	+45	
2,150 to 2,160 (2)	+45	
2,160 to 2,180 (2)	~~(1)~~ +45	....
2,180 to 2,200	+45	....
2,450 to 2,500	+45	....
2,500 to 2,686 (3)		
2,686 to 2,690 (3)	+45	....
3,700 to 4,200	+55	....
5,925 to 6,425 (3)	+55	....
6,425 to 6,525 (3)	....	+35
6,525 to 6,875 (3)	+55	....
10,550 to 10,680 (4)	~~(3)~~ +55	....
10,700 to 11,700	+55	....
12,200 to ~~13,250~~ 12,700	~~(4)~~ +50	....
12,700 to 13,250 (5)	+50	
17,700 to 18,600	+55	....
18,600 to 18,800 (5)	~~(2)~~ +35	....
18,800 to 19,700	+55	....
21,200 to 23,600 (6)	~~(4)~~ +55	....
27,500 to 29,500	+55	....

Frequency Band (MHz)	Maximum allowable EIRP (1)*	
	Fixed (dBW)	Mobile (dBW)
31,000 to 31,300	.... (3)	.... (7)
38,600 to 40,000	+55	....

*per polarization

(1) For multiple address operations, see §101.605(a)(1)(v). When an omnidirectional antenna is authorized in the 2150-2160 MHz band, the maximum power is 60 dBm. Remote alarm units that are part of a multiple address central station protection system are authorized a maximum of 2 watts.

(2) The power delivered to the antenna is limited to -3 dBW.

(3) The output power of a DEMS System nodal transmitter may not exceed 0.5 watts per 250 KHz. The output power of a DEMS System user transmitter may not exceed 0.04 watts per 250 KHz. The transmitter power in terms of the watts specified is the peak envelope power of the emission measured at the associated antenna input power. The operating power may not exceed the authorized power by more than 10 percent of the authorized power in watts at any time.

(4) Also, see §§101.145 and 101.605.

(1) For multiple address operations, see §101.147. Remote alarm units that are part of a multiple address central station protection system are authorized a maximum of 2 watts.

(2) When an omnidirectional antenna is authorized in the 2150-2160 MHz band, the maximum power shall be 60 dBm.

(3) Also, see §101.145.

(4) The output power of a DEMS System nodal transmitter shall not exceed 0.5 watts per 250 KHz. The output power of a DEMS System user transmitter shall not exceed 0.04 watts per 250 KHz. The transmitter power in terms of the watts specified is the peak envelope power of the emission measured at the associated antenna input port. The operating power shall not exceed the authorized power by more than 10 percent of the authorized power in watts at any time.

(5) Maximum power delivered to the antenna shall not exceed -3 dBW.

(6) Also, see §101.147(r).

(7) The maximum transmit power is 0.05 watts.

(b) The power of transmitters that use Automatic Transmitter Power Control shall not exceed the power input or output specified in the instrument of station authorization. The power of non-ATPC transmitters shall be maintained as near as practicable to the power input or output specified in the instrument of station authorization.

§101.115 Directional antennas.

(a) Unless otherwise authorized upon specific request by the applicant, each station authorized under the rules of this part must employ a directional antenna adjusted with the center of the major lobe of radiation in the horizontal plane directed toward the receiving station with which it communicates: *provided, however,* where a station communicates with more than one point, a multi- or omni-directional antenna may be authorized if necessary. New Periscope antenna systems will not, under ordinary circumstances, be authorized.

(b) Stations operating below 2500 MHz that are required to use directional antennas must employ antennas meeting the standards indicated below.
(Maximum beamwidth is for the major lobe of radiation at the half power points. Suppression is the minimum attenuation required for any secondary lobe signal and is referenced to the maximum signal in the main lobe.)

Frequency range	Maximum beamwidth (degrees)	Suppression (dB)
~~Below 512 MHz~~	~~80~~	~~10~~
512 to 1000 MHz	20	13
~~1500 to 2500 MHz~~	~~12~~	~~13~~

(c) Fixed stations (other than temporary fixed stations and DEMS nodal stations) operating at ~~2,500~~ 900 MHz or higher must employ transmitting and receiving antennas (excluding second receiving antennas for operations such as space diversity) meeting the appropriate performance Standard A indicated below, except that in areas not subjected to frequency congestion antennas meeting performance Standard B may be used subject to the requirements set forth in paragraph (d) of this Section.

Antenna Standards										
			Minimum radiation suppression to angle in degrees from centerline of main beam in decibels							
Frequency (MHz)	Category		Minimum antenna gain (dbi)	5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
932.5 to 935	A	14.0	n/a		6	11	14	17	20	24
941.5 to 944	B	20.0	n/a			6	10	13	15	20
952 to 960 (8) (9)	A	14.0	n/a		6	11	14	17	20	24
	B	20.0	n/a			6	10	13	15	20
1,850 to ~~1,990~~ 2,500	A	5.0	n/a	12	18	22	25	29	33	39
	B	8.0	n/a	5	18	20	20	25	28	36
3,700 to 4,200	A	n/a	36	23	29	33	36	42	55	55
	B	n/a	36	20	24	28	32	32	32	32
5,925 to 6,425 (5)	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	21	25	29	32	35	39	45
5,925 to 6,425 (6)	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	20	24	28	32	35	36	36
6,525 to 6,875 (5)	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	21	25	29	32	35	39	45
6,525 to 6,875 (6)	A	1.5	n/a	26	29	32	34	38	41	49
	B	2.0	n/a	21	25	29	32	35	39	45
10,550 to 10,680 (4)	A	n/a	38	25	29	33	36	42	55	55
(5)	B	n/a	38	20	24	28	32	35	35	39

Antenna Standards										
			Minimum radiation suppression to angle in degrees from centerline of main beam in decibels							
Frequency (MHz)	Category		Minimum antenna gain (dbi)	5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
10,550 to 10,680 (6)	A	3.4	34	20	24	28	32	35	55	55
	B	3.4	34	20	24	28	32	35	35	39
10,565 to 10,615 (7)	n/a	360	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10,630 to 10,680 (7)	n/a	n/a	34	20	24	28	32	35	36	36
10,700 to 11,700 (5)	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	20	24	28	32	35	36	36
17,700 to 18,820	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	20	24	28	32	35	36	36
18,920 to 19,700 (1)	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	20	24	28	32	35	36	36
21,200 to 23,600 (10)	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	20	24	28	32	35	36	36
31,000 to 31,300 (2) (3)	n/a	4.0	38	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Above 31,300	A	n/a	38	25	29	33	36	42	55	55
	B	n/a	38	20	24	28	32	35	36	36

(1) DEMS User Station antennas in this band must meet performance Standard B and have a minimum antenna gain of 34 dBi. The maximum beamwidth requirement does not apply to DEMS User Stations. DEMS Nodal Stations need not comply with these standards.

(2) The minimum front-to-back ratio must be 38 dBi.

(3) Mobile, except aeronautical mobile, stations need not comply with these standards.

(4) Except for antennas between 140° and 180° authorized or pending on January 1, 1989, in the band 10,550 to 10,565 MHz for which minimum radiation to suppression to angle (in degrees) from centerline of main beam is 36 decibels.

(5) These antenna standards apply to all point-to-point stations authorized after June 1, 1997. Existing licensees and pending applicants on that date are grandfathered and need not comply with these standards.

(6) These antenna standards apply to all point-to-point stations authorized on or before June 1, 1997.

(7) These antenna standards apply only to DEMS User Stations licensed, in operation, or applied for prior to July 15, 1993.

(8) Except for Multiple Address System frequencies listed in where omnidirectional antennas may be used.

(9) Antennas used at outlying stations as part of a central protection alarm system need conform to only the following 2 standards: (1) The minimum on-beam forward gain must be at least 10 dBi, and (2) the minimum front-to-back ratio must be at least 20 dB.

(10) Except as provided in Section ~~101.605~~ 101.147(t).

NOTE: Stations must employ an antenna that meets the performance standards for Category A, except that in areas not subject to frequency congestion, antennas meeting standards for Category B may be employed. Note, however, that the Commission may require the use of high performance antennas where interference problems can be resolved by the use of such antennas.

(d) The Commission ~~may require the replacement, prior to activation of the new facilities, at the licensee's expense, of~~ shall require the replacement of any antenna or periscope antenna system of a permanent fixed station operating at ~~2500~~ 900 MHz or higher that does not meet performance Standard A specified in paragraph (c) of this Section, ~~at the expense of the licensee operating such antenna,~~ upon a showing that said antenna causes or is likely to cause interference to (or receive interference from) any other authorized or applied for station whereas a higher performance antenna is not likely to involve such interference. Antenna performance is expected to meet the standards of paragraph (c) of this Section for parallel polarization. For cases of potential interference, an antenna will not be considered to meet Standard A unless the parallel polarization performance for the discrimination angle involved meets the requirements, even if the cross-polarization performance controls the interference.

(e) In cases where passive reflectors are employed in conjunction with transmitting antenna systems, the foregoing paragraphs of this section also will be applicable. However, in such instances, the center of the major lobe of radiation from the antenna normally must be directed at the passive reflector, and the center of the major lobe of radiation from the passive reflector directed toward the receiving station with which it communicates.

~~(f) New periscope antenna systems will be authorized for operation in private operational fixed stations upon a certification that the radiation, in a horizontal plane, from an illuminating antenna and reflector combination meets or exceeds the antenna standards of this section and, at locations where multiple periscope antennas are employed, that the cross-coupling between periscope antennas is suppressed by an amount equal to or greater than the radiation suppression specified in the standards for angles from the main beam of 140-180° for the particular band and antenna category selected. In no event will periscope antennas be authorized in frequency bands shared with common carriers.~~

(~~g~~f) Periscope antennas used at an electric power facility plant area will be excluded from the requirements of paragraphs (c) ~~and (e)~~ of this section on a case-by-case basis where technical considerations ~~or safety~~ preclude the use of other types of antenna systems.

(~~h~~g) In the event harmful interference is caused to the operation of other stations, the Commission may, after notice and opportunity for hearing, order changes to be made in the height, orientation, gain and radiation pattern of the antenna system.

§101.117 Antenna polarization.

~~Except as set forth herein,~~ stations operating in the radio services included in this part are not limited as to the type of polarization of the radiated signal, provided, however, that in the event interference in excess of permissible levels is caused to the operation of other stations the Commission may, after notice and opportunity for hearing, order the licensee

to change the polarization of the radiated signal. No change in polarization may be made without prior authorization from the Commission. Unless otherwise allowed, only linear polarization (horizontal or vertical) shall be used.

§101.119 Simultaneous use of common antenna structures.

NO CHANGE.

§101.121 Marking of antenna structures.

NO CHANGE.

§101.123 Quiet zones.

NO CHANGE.

§101.125 Temporary fixed antenna height restrictions.

NO CHANGE.

§101.127 Topographical data.

NO CHANGE.

§101.129 Transmitter location.

NO CHANGE.

§101.131 Transmitter construction and installation.

NO CHANGE.

§101.133 Limitations on use of transmitters.

(a) Transmitters licensed for operation in Common Carrier services may not be concurrently licensed or used for non-common carrier communication purposes except in the Multipoint Distribution Service (See Part 21 of this Chapter). However, mobile units may be concurrently licensed or used for non-common carrier communication purposes provided that the transmitter is type-accepted for use in each service.

(b) Private operational fixed point-to-point microwave stations authorized in this service may communicate with associated operational-fixed stations and fixed receivers and with units of associated stations in the mobile service licensed under Private Radio Service rule parts. In addition, intercommunication is permitted with other licensed stations and with

U.S. Government stations in those cases which require cooperation or coordination of activities or when cooperative use arrangements in accordance with §101.135 are contemplated; provided, however, that where communication is desired with stations authorized to operate under the authority of a foreign jurisdiction, prior approval of this Commission must be obtained; And provided further, That the authority under which such other stations operate does not prohibit the intercommunication.

(c) Two or more persons or governmental entities eligible for private operational fixed point-to-point microwave licenses may use the same transmitting equipment under the following terms and conditions:

(1) Each licensee complies with the general operating requirements set out in this Part.

(2) Each licensee is eligible for the frequency(ies) on which the facility operates.

(3) Each licensee must have the ability to access the transmitter(s) that it is authorized to operate under the multiple licensing arrangement.

§101.135 Shared use of radio stations and the offering of private carrier service.

(a) Licensees of Private Operational Fixed Point-to-Point Microwave radio stations may share the use of their facilities on a non-profit basis or may offer service on a for-profit private carrier basis, subject to the following conditions and limitations:

(1) Persons or governmental entities licensed to operate radio systems on any of the private radio frequencies set out in §101.101 may share such systems with, or provide private carrier service to, any eligible for licensing under this part, regardless of individual eligibility restrictions, provided that the communications being carried are permissible under §101.603.

(2) The licensee must maintain access to and control over all facilities authorized under its license.

(3) All sharing and private carrier arrangements must be conducted pursuant to a written agreement to be kept as part of the station records.

(4) The licensee must keep an up-to-date list of system sharers and private carrier subscribers and the basis of their eligibility under this part. Such records must be kept current and must be made available upon request for inspection by the Commission.

§101.137 Interconnection of private operational fixed point-to-point microwave stations.

Private operational fixed point-to-point microwave stations may be interconnected with facilities of common carriers subject to applicable tariffs.

§101.139 Authorization of transmitters.

(a) Except for transmitters used at developmental stations or for fixed point-to-point operation pursuant to Subparts H and I, each transmitter must be a type which has been type accepted by the Commission for use under the applicable rules of this part. Transmitters used in the private operational fixed and common carrier fixed point-to-point microwave services under Subparts H and I ~~for fixed operation~~ must be of a type that has been either notified or type accepted by the Commission (see Sec. 2.904(d) of this chapter). Effective March 5, 1984, only grants of notification will be issued for transmitters used exclusively for fixed point-to-point operation. Transmitters designed for use in the 31.0 to 31.3 GHz band will be authorized under the notification procedure.

(b) Any manufacturer of a transmitter to be produced for use under the rules of this part may request type acceptance or notification by following the applicable procedures set forth in Part 2 of this chapter. Type accepted and notified transmitters are included in the Commission's Radio Equipment List. Copies of this list are available for inspection at the Commission's office in Washington, D.C. and at each of its field offices.

(c) Type acceptance or notification for an individual transmitter may also be requested by an applicant for a station authorization, pursuant to the procedures set forth in Part 2 of this chapter. An individual transmitter will not normally be included in the Radio Equipment List but will be enumerated on the station authorization.

(d) A transmitter presently shown on an instrument of authorization, which operates on an assigned frequency in the 890-940 MHz band and has not been type accepted, may continue to be used by the licensee without type acceptance provided such transmitter continues otherwise to comply with the applicable rules and regulations of the Commission.

(e) Type acceptance or notification is not required for portable transmitters operating with peak output power not greater than 250 mW. If operation of such equipment causes harmful interference the FCC may, at its discretion, require the licensee to take such corrective action as is necessary to eliminate the interference.

(f) After July 15, 1996, the manufacture (except for export) or importation of equipment employing digital modulation techniques in the 3700-4200, 5925-6425, 6525-6875, 10,550-10,680 and 10,700-11,700 MHz bands must meet the minimum payload capacity requirements of ~~§101.139.~~ §101.141.

§101.141 Microwave ~~digital~~ modulation.

(a) Microwave transmitters employing digital modulation techniques and operating below ~~15~~ 19.7 GHz must, with appropriate multiplex equipment, comply with the following additional requirements:

(1) The bit rate, in bits per second, must be equal to or greater than the bandwidth specified by the emission designator in Hertz (e.g., to be acceptable, equipment transmitting at a 20 Mb/s rate must not require a bandwidth of greater than 20 MHz), except the bandwidth used to calculate the minimum rate may not include any authorized guard band.

NOTE: ~~Until December 1, 1988, no minimum bit rate will apply to the 17,700-19,700 MHz band.~~ Systems authorized prior to ~~that date~~ December 1, 1988 may install equipment after that date with no minimum bit rate.

(2) Equipment to be used for voice transmission placed in service, authorized, or applied for on or before June 1, 1997 in the 2110 to 2130 and 2160 to 2180 MHz bands must be capable of satisfactory operation within the authorized bandwidth to encode at least 96 voice channels. Equipment placed in service, authorized, or applied for on or before June 1, 1997 in the 3700-4200, 5925-6425 (30 MHz bandwidth), and 10,700-11,700 MHz (30 and 40 MHz bandwidths) bands must be capable of satisfactory operation within the authorized bandwidth to encode at least 1152 voice channels. These required loading levels may be reduced by a factor of 1/N provided that N transmitters may be operated satisfactorily, over the same radio path, within an authorized bandwidth less than, or equal to, the maximum authorizable bandwidth (e.g., the 1152 channel requirement may be reduced to 576 if two transmitters can be satisfactorily operated over the same path within the maximum bandwidth). Where type accepted equipment is designed to operate on the same frequency in a cross polarized configuration to meet the above capacity requirements, the Commission will require, at the time additional transmitters are authorized, that both polarizations of a frequency be used before a new frequency assignment is made, unless a single transmitter installation was found to be justified by the Commission at the time it authorized the first transmitter.

(3) The following capacity and loading requirements must be met for equipment applied for, authorized, and placed in service after June 1, 1997 in the 3700-4200 MHz (4 GHz), 5925-6425 and 6525-6875 MHz (6 GHz), 10,550-10,680 MHz (10 GHz), and 10,700-11,700 MHz (11 GHz) bands:

Nominal Channel Bandwidth (MHz)	Minimum Payload Capacity (Mbits/s) (1)	Minimum Traffic Loading Payload (as percent of payload capacity)	Typical Utilization*
0.400	1.54	n/a	1 DS-1
0.800	3.08	n/a	2 DS-1
1.25	3.08	n/a	2 DS-1
1.60	6.17	n/a	4 DS-1
2.50	6.17	n/a	4 DS-1
3.75	12.3	n/a	8 DS-1
5.0	18.5	n/a	12 DS-1
10.0	44.7	50**	1 DS-3/STS-1
20.0	89.4	50**	2 DS-3/STS-1
30.0 (11 GHz)	89.4	50**	2 DS-3/STS-1
30.0 (6 GHz)	134.1	50**	3 DS-3/STS-1
40.0	134.1	50**	3 DS-3/STS-1

* DS and STS refer to the number of voice circuits a channel can accommodate. 1 DS-1 = 24 voice circuits; 2 DS-1 = 48; 4 DS-1 = 96; 8 DS-1 = 192; 12 DS-1 = 288; 1 DS-3/STS-1 = 672; 2 DS-3/STS-1 = 1344; 3 DS-3/STS-1 = 2016.

** This loading requirement must be met within 30 months of licensing. If two transmitters simultaneously operate on the same frequency over the same path, the requirement is reduced to 25 percent.

(1) Per polarization

(4) If a transmitter is authorized to operate in a bandwidth that is not listed in paragraph (a)(3) of this section, it must meet the minimum payload capacity and traffic loading requirements of the next largest channel bandwidth listed in the table; e.g., if the authorized bandwidth is 3.5 MHz, the minimum payload capacity must be 12.3 Mbits/s.

(5) Transmitters carrying digital motion video motion material are exempt from the requirements specified in paragraphs (a)(2) and (a)(3) of this section, provided that at least 50 percent of the payload is digital video motion material and the minimum bit rate specified in paragraph (a)(1) is met. In the 6, 10, and 11 GHz bands, concatenation of multiple contiguous channels is permitted for channels of equal bandwidth on center frequencies, provided no other channels are available and the minimum payload capacity requirements are met.

~~(6) Digital [illegible] MHz or larger shall be considered 50 percent loaded when the following conditions exist: at least 50 percent of their total DS-1 capacity is being used. A DS-1 channel is being used when it has been connected to a DS-0/DS-1 multiplexer. For non-DS-0 services, such as, but not limited to, video or broadband data transmission, the next largest DS-1 equivalent will be considered for the computation of a loading percentage.~~

~~(7) For digital systems, minimum payload capacities shall be expressed in numbers of DS-1s, DS-3s or STS-1s. The payload capacity required by the Commission shall correspond to commercially available equipment.~~

(b) For purposes of compliance with the emission limitation requirements of §101.111(a)(2) of this part and the requirements of paragraph (a) of this section, digital modulation techniques are considered as being employed when digital modulation occupies 50 percent or more to the total peak frequency deviation of a transmitted radio frequency carrier. The total peak frequency deviation will be determined by adding the deviation produced by the digital modulation signal and the deviation produced by any frequency division multiplex (FDM) modulation used. The deviation (D) produced by the FDM signal must be determined in accordance with §2.202(f) of Part 2 of this chapter.

~~(c) Transmitters employing digital modulation techniques must effectively eliminate carrier spikes or single frequency tones in the output signal to the degree which would be obtained without repetitive patterns occurring in the signal.~~

~~(d) Transmitters type accepted for use with digital modulation prior to November 1, 1974 may continue to be used where authorized until December 31, 1976. After the latter date, such equipment will no longer be type accepted for digital modulation unless it is type accepted for such use after November 1, 1974.~~

~~(e) Microwave transmitters employing digital modulation techniques in the bands 17,700-19,700 MHz must transmit at bit rate, in bits per second (bps), equal to or greater than the authorized bandwidth in Hertz (e.g., to be acceptable, equipment transmitting at a 20 Mbps rate must not require an authorized bandwidth greater than 20 MHz). This bps/Hz standard is independent of the antenna (polarization) used, frequency reuse, or how the system is configured.~~

~~(f) Analog Microwave. Except for renewal applications, an application for an initial working channel for a given route will not be accepted for filing where the anticipated loading (within five years of the date the earliest proposed station is to be capable of projection) is less than the minimum specified for the following frequency bands. Absent extraordinary circumstances, applications proposing additional frequencies over existing routes will not be granted unless it is shown that the traffic load will shortly exhaust the capacity of the existing equipment. Where no construction of radio facilities is requested, licensees must submit this evidence with their filing of any necessary authority required pursuant to section 214 of the Communications Act and Part 63 of this chapter.~~

~~Frequency Band (MHz)~~	~~Minimum Number of Voice Channels (4 KHz or equivalent)~~
~~3700 to 4200 (20 MHz bandwidth)~~	~~600 450~~
~~5925 to 6425 (10 MHz bandwidth)~~	~~300 150~~
~~5925 to 6425 (20 MHz bandwidth)~~	~~600 300~~
~~5925 to 6425 (30 MHz bandwidth)~~	~~900 450~~
~~6425 to 6875 (10 MHz bandwidth)~~	~~300 150~~
~~10,700 to 11,700 (10 MHz bandwidth)~~	~~300 150~~
~~10,700 to 11,700 (20 MHz bandwidth)~~	~~600 300~~
~~10,700 to 11,700 (30 MHz bandwidth)~~	~~900 450~~
~~10,700 to 11,700 (40 MHz bandwidth)~~	~~900 450~~

§101.143 Minimum path lengths ~~for fixed lengths.~~ requirements.

(a) The distance between end points of a fixed link in the private operational fixed ~~service~~ point-to-point and the common carrier fixed point-to-point microwave ~~service~~ services must equal or exceed the value set forth in the table below or the EIRP must be reduced in accordance with the equation set forth below.

Frequency Band (MHz)	Minimum path length (km)
Below 1,850	n/a
1,850 to 7,125	17
10,550 to 13,250	5
Above 17,700	n/a

(b) For paths shorter than those specified in the Table, the EIRP ~~may~~ shall not exceed the value derived from the following equation.

EIRP = ~~30 + 20 log[A/B], dBW~~ MAXEIRP - 40*log(A/B) dBW

Where:
EIRP=Equivalent isotropic radiated power in dBW.
A=Minimum path length from the Table for the frequency band in kilometers.
B=The actual path length in kilometers.
~~X=The power set forth as follows. For systems that use a channel bandwidth equal to or greater than 10 MHz, and meet the loading requirements given in §101.141(e)(2) for digital or Section 101.141(e) for analog, x = the maximum allowable EIRP for the band given in §101.113(a) minus 10 dB. For all other systems, x = 30.~~

~~NOTE: Automatic transmit power control may be used to meet this requirement up to a 3 dB increase in EIRP.~~

NOTE: For transmitters using Automatic Transmit Power Control, EIRP that corresponds to the maximum transmitter power must satisfy this requirement.

(c) Upon an appropriate technical showing, applicants and licensees unable to meet the minimum path length requirement may be granted an exception to these requirements.

Note: Links authorized prior to April 1, 1987, need not comply with this requirement.

§101.145 Interference to geostationary-satellites.

NO CHANGE.

§101.147 Frequency assignments. [CONSOLIDATED §§101.605 AND 101.703. CHANGES NOT SHOWN]

(a) Frequencies in the following bands are available for assignment to fixed radio point-to-point microwave stations.

928.0 - 929.0 MHz /22/
932.0 - 932.5 MHz /22/
932.5 - 935 MHz /17/
941.0 - 941.5 MHz /17/ /18/
952.0 - 960.0 MHz /22/
1,850 - 1,990 MHz /22/
2,110 - 2,130 MHz /1/ /3/ /7/ /20/
2,130 - 2,150 MHz /22/
2,150 - 2,160 MHz /22/
2,160 - 2,180 MHz /1/ /2/ /20/ /21/
2,180 - 2,200 MHz /22/
2,450 - 2,500 MHz /22/
2,650 - 2,690 MHz /22/
3,700 - 4,200 MHz /8/ /14/ /25/
5,925 - 6,425 MHz /6/ /14/ /25/
6,425 - 6,525 MHz /24/
6,525 - 6,875 MHz /14/
10,550 - 10,680 MHz /19/
10,700 - 11,700 MHz /8/ /9/ /19/ /25/
11,700 - 12,200 MHz /24/
12,200 - 12,500 MHz /22/
12,500 - 12,700 MHz /22/
12,700 - 13,200 MHz /22/
13,200 - 13,250 MHz /4/ /24/ /25/
14,200 - 14,400 MHz /24/
17,700 - 18,820 MHz /5/ /10/ /15/
18,820 - 18,920 MHz /22/
18,920 - 19,160 MHz /5/ 10/ /15/
19,160 - 19,260 MHz /22/
19,260 - 19,700 MHz /5/ /10/ /15/
21,200 - 22,000 MHz /4/ 11/ /12/ /13/ /24/ /25/ /26/
22,000 - 23,600 MHz /4/ /11/ /12/ /24/ /25/ /26/
27,500 - 29,500 MHz /5/
31,000 - 31,300 MHz /16/ /24/
38,600 - 40,000 MHz /4/
Bands Above 40,000 MHz

/1/ Frequencies in this band are shared with control and repeater stations in the Domestic Public Land Mobile Radio Service and with stations in the International Fixed Public Radiocommunication Services located south of 25° 30' north latitude in the State of Florida and U. S. possessions in the Caribbean area. Additionally, the band 2160-2162 MHz is shared with stations in the Multipoint Distribution Service.

/2/ Except upon showing that no alternative frequencies are available, no new assignments will be made in the band 2160-2162 MHz for stations located within 80.5 kilometers (50 miles) of the coordinates of the cities listed in §21.901(c) of this chapter.

/3/ Television transmission in this band is not authorized and radio frequency channel widths may not exceed 3.5 MHz.

/4/ Frequencies in this band are shared with fixed and mobile stations licensed in other services.

/5/ Frequencies in this band are shared with stations in the fixed-satellite service.

/6/ These frequencies are not available for assignment to mobile earth stations.

/7/ Frequencies in the band 2110-2120 MHz may be authorized on a case-by-case basis to Government or non-Government space research earth stations for telecommand purposes in connection with deep space research.

/8/ This frequency band is shared with station(s) in the Local Television Transmission Service and, in the U.S. Possessions in the Caribbean area, with stations in the International Fixed Public Radiocommunications Services.

/9/ The band segments 10.95 - 11.2 and 11.45 - 11.7 GHz are shared with space stations (space to earth) in the fixed-satellite service.

/10/ This band is co-equally shared with stations in the fixed services under Parts 74, 78 and 101 of the Commission's Rules.

/11/ Frequencies in this band are shared with Government stations.

/12/ Assignments to common carriers in this band are normally made in the segments 21.2 - 21.8 GHz and 22.4 - 23.8 GHz and to operational fixed users in the segments 21.8 - 22.4 GHz and 23.0 -23.6 GHz. Assignments may be made otherwise only upon a showing that no interference free frequencies are available in the appropriate band segments.

/13/ Frequencies in this band are shared with stations in the earth exploration satellite service (space to earth).

/14/ Frequencies in this band are shared with stations in the fixed-satellite and private operational fixed point-to-point microwave services.

/15/ Stations licensed as of September 9, 1983 to use frequencies in the 17.7 - 19.7 GHz band may, upon proper application, continue to be authorized for such operation.

/16/ Frequencies in this band are co-equally shared with stations in the Auxiliary Broadcasting (Part 74), Cable Television Relay (Part 78), Private Operational Fixed Point-to-Point Microwave (Part 101) and General Mobile Radio (Part 95) Services. Use of this spectrum for direct delivery of video programs to the general public or multi-channel cable distribution is not permitted.

/17/ Frequencies in these bands are shared with Government fixed stations and stations in the Private Operational Fixed Point-to-Point Microwave Service (Part 101).

/18/ Frequencies in the 942 to 944 MHz band are also shared with broadcast auxiliary stations (Part 74).

/19/ Frequencies in this band are shared with stations in the private-operational fixed point-to-point microwave service.

/20/ New facilities in these bands will be licensed only on a secondary basis. Facilities licensed or applied before January 16, 1992, are permitted to make modifications and minor extensions and retain their primary status.

/21/ Any authorization of additional stations to use the 2160-2162 MHz band for Multipoint Distribution Service applied for after January 16, 1992, will be secondary to use of the band for emerging technology services.

/22/ Frequencies in these bands are for the exclusive use of Private Operational Fixed Point-to-Point Microwave Service (Part 101).

/23/ Frequencies in these bands are for the exclusive use of Common Carrier Fixed Point-to-Point Microwave Service (Part 101).

/24/ Frequencies in these bands are available for assignment to television pickup and television non-broadcast pickup stations. The maximum power for the local television transmission service in the 14.2 - 14.4 GHz band is +45 dBW except that operations are not permitted within 1.5 degrees of the geostationary orbit.

/25/ Frequencies in these bands are available for assignment to television STL stations.

/26/ Frequency pairs 21.825/23.025 GHz, 21.875/23.075 GHz, 21.925/23.125 GHz, and 21.975/23.175 GHz may be authorized for low power, limited coverage, systems subject to the provisions of paragraph (r) hereof.

Frequencies normally available for assignment in this service are set forth with applicable limitations in the following tables:

(b) 928 - 960 MHz Multiple address system (MAS) frequencies are available for the point-to-multipoint transmission of a licensee's products or services, excluding video entertainment material, to a licensee's customer or for its own internal communications. The paired frequencies listed in this section are used for two-way interrogate/response communications between a master station and remote stations. Each master station operating on these frequencies is required to serve a minimum of four separate active remote stations. Ancillary one-way communications on paired frequencies are permitted on a case-by-case basis. Ancillary communications between interrelated master stations are permitted on a secondary basis. The normal channel bandwidth assigned will be 12.5 KHz. Upon adequate justification, however, channels with bandwidths up to 50 KHz may be authorized. Tables 2, 4, and 6 list frequencies with 25 KHz bandwidth channels. When licensed for a larger bandwidth, the system still is required to use equipment that meets the +/-0.00015 percent tolerance requirement. (See §101.107). Systems licensed for frequencies in these MAS bands prior to August 1, 1975, may continue to operate as authorized until June 11, 1996, at which time they must comply with current MAS operations based on the 12.5 KHz channelization set forth in this paragraph. Systems licensed between August 1, 1975, and January 1, 1981, inclusive, are required to comply with the grandfathered 25 KHz standard bandwidth and channelization requirements set forth in this paragraph. Systems originally

licensed after January 1, 1981, and on or before May 11, 1988, with bandwidths of 25 KHz and above, will be grandfathered indefinitely.

(1) General Access Pool: Frequencies listed in this paragraph are available to all persons eligible under this Part for use in multiple address radio systems. Except as noted, however, the frequencies may be used by eligibles in the Power Radio Service only if the frequencies in subparagraph (2) of this Section are exhausted in the particular geographic area. The frequencies are also available for shared use by Part 22 Public Land Mobile Service users if frequencies listed in Sec. 22.50(g) of this chapter are exhausted in the particular geographic area. Applications for use of these frequencies under Part 22 are subject to Part 101 requirements.

Table 1-Paired Frequencies (MHz)

(12.5 KHz bandwidth)

Remote transmit	Master transmit
928.00625	952.00625
928.01875	952.01875
928.03125	952.03125
928.04375	052.04375
928.05625	952.05625
928.06875	952.06875
928.08125	952.08125
928.09375	952.09375
928.10625	952.10625
928.11875	952.11875
928.13125	952.13125
928.14375	952.14375
928.15625	952.15625
928.16875	952.16875
928.18125	952.18125
928.19375	952.19375
928.20625	952.20625
928.21875	952.21875
928.23125	952.23125
928.24375	952.24375
928.25625	952.25625
928.26875	952.26875
928.28125	952.28125
928.29375	952.29375

928.30625	.....	952.30625
928.31875	.....	952.31875
928.33125	.....	952.33125
928.34375	.....	952.34375

Unpaired Frequencies (MHz)/1/

(12.5 KHz bandwidth)

956.25625	956.33125	956.39375
956.26875	956.34375	956.40625
956.28125	956.35625	956.41875
956.29375	956.36875	956.43125
956.30625	956.38125	956.44375
956.31875		

/1/ Available to power eligibles regardless of whether frequencies in the power pool are exhausted.

Table 2-Paired Frequencies (MHz)

(25 KHz bandwidth)

Remote transmit		Master transmit
928.0125	.....	952.0125
925.0375	.....	952.0375
928.0625	.....	952.0625
928.0875	.....	952.0875
928.1125	.....	952.1125
928.1375	.....	952.1375
928.1625	.....	952.1625
928.1875	.....	952.1875
928.2125	.....	952.2125
928.2375	.....	952.2375
928.2625	.....	952.2625
928.2875	.....	952.2875
928.3125	.....	952.3125
928.3375	.....	952.3375

Unpaired frequencies (MHz)/1/

(25 KHz bandwidth)

956.2625	956.3375	956.4125
956.2875	956.3625	956.4375
956.3125	956.3875	

/1/ Available to power eligibles regardless of whether frequencies in the power pool are exhausted.

(2) Power Pool: Frequencies listed in this paragraph are available to persons eligible under Sec. 90.63 of this chapter for licensing in the Power Radio Service for use in multiple address radio systems. After January 1, 1992, the frequencies are also available for use by general access pool users and Part 22 Public Land Mobile Service users (Sec. 22.501(g) of this chapter) provided frequencies listed in their respective pools are exhausted in the particular geographic area. Applications for use of these frequencies under Part 22 of this chapter are subject to Part 101 of this chapter requirements.

Table 3-Paired Frequencies (MHz)

(12.5 KHz bandwidth)

Remote transmit	Master transmit
928.35625	952.35625
928.36875	952.36872
928.38125	952.38125
928.39375	952.39375
928.40625	952.40625
928.41875	952.41875
928.43125	952.43125
928.44375	952.44375
928.45625	952.45625
928.46875	952.46875
928.48125	952.48125
928.49375	952.49375
928.50625	952.50625
928.51875	952.51875